Improving STT digitization

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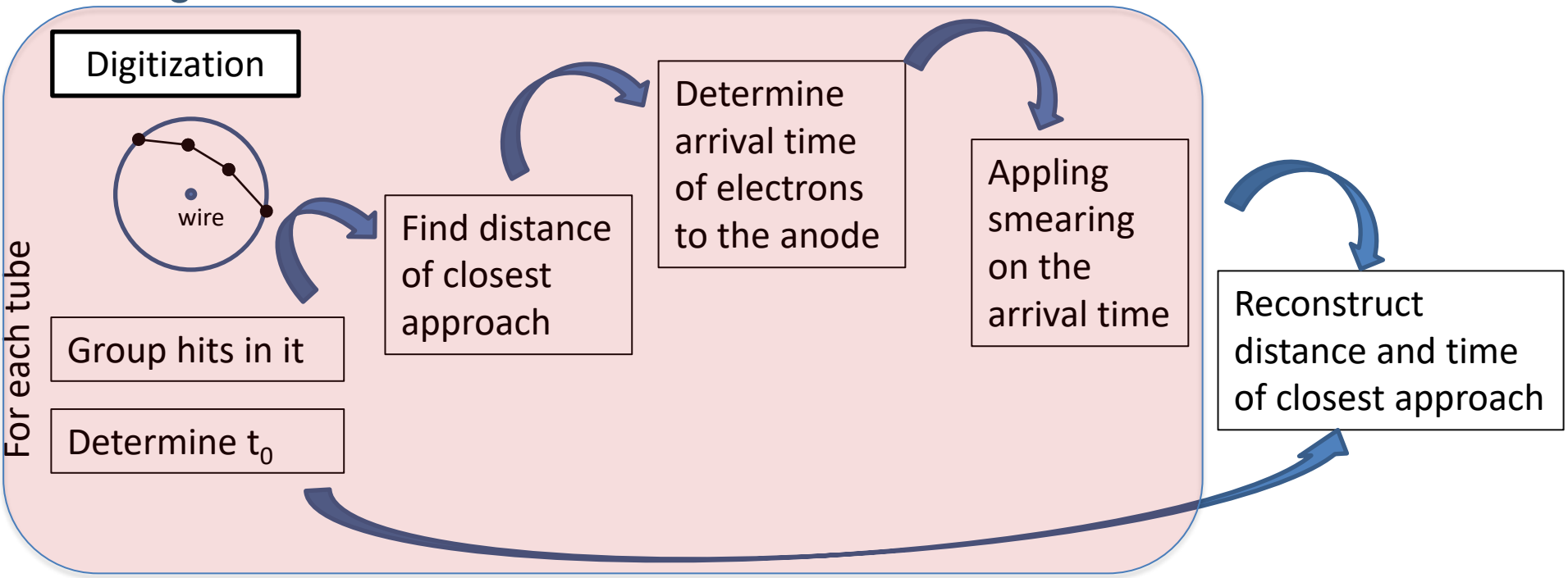
Overview

- Now: STT digitization = time and spatial smearing of STT hit
- Aim: implement a more realistic STT digitization w/ ADC and TDC for each tube
- Algorithm:



Determine t_0

- Assuming we identified the bucket that generate the interacting neutrino, we can assign a t_0 to every tube

$$t_0 = t_{bucket} + \frac{z_{tub} - z_{tgt}}{c} + Gaus(1ns)$$

- $z_{tub} - z_{tgt}$ is the distance between proton target and tube
- Bucket has a width of 1 ns (RMS)
- Practically:

$$t_0 = t_{bucket} + \left[\frac{z_{int} - z_{tgt}}{c}\right] + \left[\frac{z_{tub} - z_{int}}{c}\right] + Gaus(1ns)$$

$$t_0 = t_{int} + \left[\frac{z_{tub} - z_{int}}{c}\right] + Gaus(1ns)$$

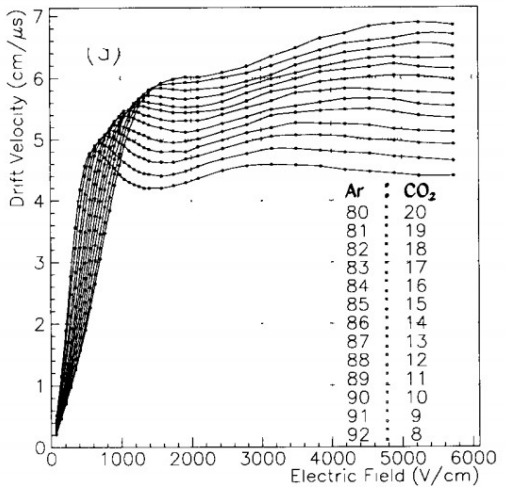
- z_{int}, t_{int} are the z position and time of the neutrino interaction

Arrival time of electrons to the anode

- Given the position $(\vec{x}, t)$ of closest approch, determine the drift length (Δr) and time (Δt)
- Drift velocity $v_{drift} \sim 5\ cm/\mu s$
- Apply a smearing of 3.5 ns (TDC)

$$t_{arr} = t + \frac{\Delta r}{v_{drift}} + Gaus(3.5\ ns)$$

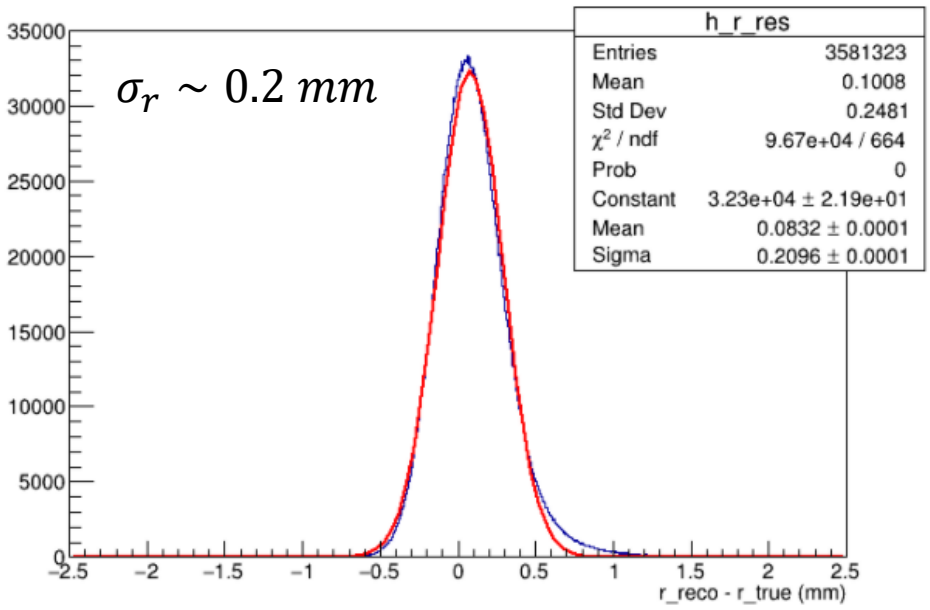
- ADC is propotional to the sum of energy deposition in a time window of 400 ns

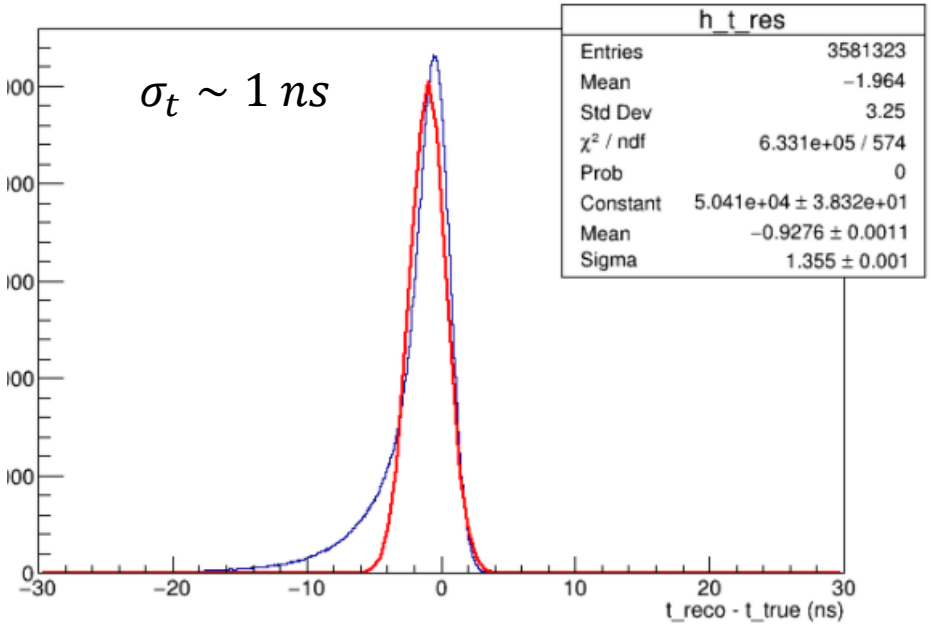


https://doi.org/10.1016/0168-9002(94)90129-5

Reconstruct radius and time

- $\Delta r_{drift} = (t_{arr} - t_0) \times v_{drift}$
- $r_{reco} = \Delta r_{drift} + r_{wire}$
- $t_{reco} = t_{arr} - \Delta r_{drift}/v_{drift}$





Conclusions and outlooks

- An algorithm for STT digitization has been defined
- $\sigma_r = 200\ \mu m;\ \sigma_t = 1\ ns$
- Implemented in kloe-simu in branch: feature/stt_digitization
- Soon also in: sand-stt repository